Chemistry I: Percent Composition and Formula Determination Steps

To calculate the molar mass of a compound:

1. Add up the atomic masses of all of the atoms of each element in the compound. This number will be in atomic mass units (amu). Since we cannot weigh atoms in amu's; we simply convert amu's to grams. This is called the gram-molecular or gram-formula weight of a substance. This happens to be the mass of one mole (hence called molar mass) of that substance. A mole is a unit of measurement that chemists use to measure the amount of matter. A mole of anything has 6.02×10^{23} particles. These particles can be atoms, ions, or molecules. Since we cannot count out such a large number we simply weigh the substance (compounds or elements) in grams.

To calculate the percent composition of a **component in** a **compound:**

1. Find the molar mass of the compound by adding up the masses of each atom in the compound using the periodic table.
2. Calculate the mass due to each element in the compound that you are solving for by adding up the mass of these atoms.
3. Divide the mass due to each element by the total molar mass of the compound and multiply by 100.

$$\text{Percent Composition} = \frac{\text{mass of specific element}}{\text{molar mass of compound}} \times 100\ \%$$

Steps for Determining an Empirical Formula

Empirical Formula -A formula that gives the simplest whole-number ratio of atoms in a compound.

1. Start with the number of grams of each element, given in the problem.
If percentages are given, assume that the total mass is 100 grams so that the mass of each element = the percent given.
2. Convert the mass of each element to moles using the molar mass from the Periodic table.

3. Divide each mole value by the smallest number of moles calculated.

4. Round to the nearest whole number. This is the mole ratio of the elements and is represented by subscripts in the empirical formula.

- If the number is too far to round (x.l ~ x.9), then multiply each solution by the same factor to get the lowest whole number multiple.
  e.g. If one solution is 1.5, then multiply each solution in the problem by 2 to get 3.
  e.g. If one solution is 1.25, then multiply each solution in the problem by 4 to get 5.

Once the empirical formula is found, the molecular formula for a compound can be determined if the molar mass of the compound is known. Simply calculate the mass of the empirical formula and divide the molar mass of the compound by the mass of the empirical formula to find the ratio between the molecular formula and the empirical formula. Multiply all the atoms (subscripts) by this ratio to find the molecular formula. (See Example #2)

For any kind of molecular compound, we can write:

$$\text{Molecular weight} = n * \text{empirical formula weight}$$

where n is the number of empirical formula units in a compound. We can get the molecular formula by multiplying the subscripts of the empirical formula by whatever n is.

We can calculate this from the equation: $n = (\text{molecular weight})/(\text{empirical formula weight})$